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Capillary Aggregation of Nanofilaments into Superstructures

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Over the past decades, methods have been developed to coat surfaces with high aspect ratio nanofilaments for applications including supercapacitors, solar cells, superhydrophobic surfaces, and biomimetic adhesives. Importantly, these nanofilaments often come in contact with wet environments during their synthesis, post-treatment, or in their final application. Because high aspect ratio nanofilaments have a very low stiffness, they can easily be manipulated by capillary interactions. Upon drying for instance, capillary forces can collapse nanofilaments into random aggregates, which is typically an unwanted effect. However, new studies show that by understanding and controlling capillary aggregation, it is possible to fabricate complex and robust architectures in a scalable manner [1]. Besides providing an overview of the above developments, this talk will focus on a process we are developing towards the capillary aggregation of vertically aligned carbon nanotubes "forests." We found capillary aggregation to be an effective method for increasing nanotube packing density, but also to form complex nanotube superstructures. These were for instance integrated in microsensors and other MEMS devices. This talk is based on joint research with AJ Hart, S Tawfick, SJ Park and D Copic.

[1] Engineering Hierarchical Nanostructures by Elastocapillary Self-Assembly, M De Volder, AJ Hart, Angewandte Chemie, 52 (9), 2412-2425